Qualitative analysis - intro, data collection

Welcome to module 5, Tools and Techniques to Analyze or Study Movement. So, in this module we will be looking at qualitative analysis. We will be looking at what qualitative analysis is and some of the data collection techniques or data collection considerations and also some of the softwares that we can use for qualitative analysis and the advantages and disadvantages of this approach. So, in the entire module of tools and techniques to study movement, of course, there are different ones from qualitative, quantitative and computer simulation modeling, right? You will be looking at these in the upcoming videos or upcoming modules. The purpose of this one, we will be looking at qualitative analysis. So, the learning outcomes would be introduction to what qualitative analysis is, how do we interpret the data, so qualitative interpretation and data collection considerations.

We will also be looking at some of the advantages and disadvantages and tools for qualitative analysis. So, what is qualitative analysis? So, qualitative analysis in movement science is basically the systematic observation and the understanding or the study of the quality of the movement. So, it is basically an introspective judgment and a systematic observation for the quality of the human movement. So, examination and interpretation of the underlying movement patterns and mechanics without the use of numeric data is another definition for qualitative analysis.

You do not use numeric data in this aspect, whereas in quantitative analysis, you would use numeric data. So, of course, this type of analysis or this type of an approach has an advantage and disadvantages, and we look at them in the next few slides. All this approach does is gives us an overall understanding of the quality, efficiency and effectiveness of movement. So, because we cannot dwell into numbers, it has its own limitation, but we can have an introspection into the quality of the movement, efficiency and effectiveness. So, let us look at qualitative interpretation.

So, qualitative interpretation within movement analysis traditionally involves, so what do we identify? It involves the identification of errors, so where the athlete is going wrong or where the individual is going wrong, where there is a scope of improvement or technical errors. We can also identify what are the underlying patterns. So, we have looked at or we will be looking at the difference between technique and style, what constitutes technique, what constitutes style and what are the underlying movement patterns and how we can identify them through qualitative analysis. We can also identify functional discrepancies. So of course, objectively identifying functional discrepancies requires different scans, but we can look at, you know, if the movement is inefficiently performed or the quality is compromised, is that due to some kind of discrepancies.

So it helps us to optimize performance and reduce the risk of injury. So if we can identify all of these things with a common goal to optimize performance and to reduce or pre-attempt or preempt the risk of injury, we are in a good position. It also helps us highlight areas where the individual's movement is sub-optimal or lacking efficiency. So, you can also identify that through this qualitative analysis. Also if there is a requirement and coaches do have requirements or sports scientists do have requirements, biomechanists do have these requirements to continuously keep on assessing the technique through the sessions and the sessions happening quite often.

So, regular reassessment and feedback to monitor the progress of an athlete. So, if you are working on an athlete's technique and you need to keep on continuously monitoring the feedback, that's why qualitative analysis gives you an overall or a comprehensive view and it assists you to monitor progress, ensures that recommended interventions or any kind of protocols that you might have set produce the desired outcome. So you can keep a track of them. Now let's look at some of the considerations for qualitative analysis when you're collecting the data. To qualitatively analyze the movement, the data that you will be collecting will be with the use of video cameras.

Now, although it's just a video camera on a tripod, there are different specs, there are different settings, there are different considerations for you to effectively have good quality data and to be able to predict or to be able to analyze the movement pattern that you want to study. So, for us to be able to do that, let's look at some of the considerations for a good qualitative analysis setup and analysis. So, let's look at a tripod and the camera setup and some of the considerations. So, make sure you attach the camera to the tripod, adjust it at a level, you would have different levels and the camera is balanced on the tripod and the camera axis is at 90 degrees to the movement plane. So for example, let's consider an example here.

So, if the subject is here, right, so that's your subject and you are looking at a movement, so either place the camera here, right, or you either place it here. So this is around, always at around 90 degrees to the movement. Imagine if you place a camera here, right, what happens? All of the movements that we studied in our functional anatomy of how the body moves, right, respect to the our axis and planes of motions, you will not be able to achieve that or see that optimally from a different angle. So, you make sure that whenever you are adjusting the tripod or you are placing the tripod, it is at 90 degrees to the movement that is happening. So, you need to set up the tripod in such a way that it is at an appropriate distance.

So, you don't want to view where this individual is cut in half, right, or you don't want to view where you have such a big composition or frame where the individual is hardly seen. So, you place a tripod at a distance where the individual is optimally seen. You also place it at a height again, roughly at the center of the vertical movement range. So

imagine that you're doing some, why would this be important? Sorry, why would this be important? Imagine you're doing a movement of a vertical jump, right? So you need to place the camera in such a way that when the athlete is achieving this vertical jump, you're able to capture that volume or the vertical volume range of movement as well, right? So, you might have athletes with different heights, right? So, you need to optimize this distance for every athlete or an individual athlete according to their height and their capacity to vertically jump as well. So, it's roughly in the center of their vertical movement range.

Also, sometimes when you're doing movements that require athletes to travel a horizontal distance and you want to capture the entire volume, you need to place it at roughly center of the horizontal range. Another consideration would be to zoom onto the objects. As we spoke about earlier, you don't want an entire frame where the athlete is just like a little minuscule there. You want it to be zoomed into the object, the object as in your object of attention. So, here it's the athlete in the movement plane.

So, focus the camera, zoom onto the athletes, so you can capture the entire vertical and the horizontal range and then zoom out until the camera view is slightly larger, right? So, you don't want it to be, you know, even fitting to the athletes. So, it's slightly larger than the movement capture volume, right? So, it's important tripod and camera setup. So, let's look at some of the camera settings that are important. So, for example, frame rate. So, what is frame rate? It's the number of frames that you record the activity over per second, right? So, that's your frame rate, number of frames per second.

And how would this be important, right? So, for us to record with a higher frame rate is quite important. So, the number of frames that you record your camera setting is at is important to capture rapid movements. So, if your frame rate is low, you will have a blur effect, right? So, for rapid movements, you need a higher frame rate. So, now what's a good frame rate? So, frame rate of over 100 frames per second, right? So, that's a minimum requirement for sporting skills is recommended for capturing your fast movements in sport accurately, right? So, frame rate as a concept is extremely important, right? So, let's look at some of the other camera settings, right? Another important concept to consider here of the camera settings is the aperture. So, what is aperture? So, the aperture affects the brightness of the image or the video that you are capturing, right? And also the depth of field, so the depth at which the subject is at, the depth at which it is capturing, right? So, smaller aperture would give you great depth of field, which is advantageous.

You don't have like a large aperture as well, right? So, adjust the aperture to control the depth of field, right? So, ensuring all of your body segments, so if you are looking at something specific, just at the shoulder, if you are looking at the wrist or if you are looking at the overall movement, you need to adjust the aperture in such a way that all of

your body segments that you are looking at are in focus. And at the same time, you are minimizing the distractions at the background, right? So, that is how aperture is important. Let us look at another concept of shutter speed. So, what is shutter speed? So, it is the speed at which the shutter of your camera opens and shuts. So, the speed at which the shutter of your camera opens and shuts.

So, it is the length of the time the camera shutter is open. So, it is your exposure time. You would be knowing a lot in the camera settings about exposure, right? So, it is the exposure time. So, slower the shutter speed, there will be a blur effect, whereas high shutter speed, image will be darker. So, you need to adjust it in such a way that the shutter speed is optimized.

Set the shutter speed appropriately to avoid motion blur and maintain optimal exposure. So, you do not even want it to be blurred, you do not even want it to be darker. It needs to be at a really good sweet spot. Along with the shutter speed, you also need to adjust what is called as the white balance. So, set the white balance to ensure accurate color representation.

You do not want too much white crashing. You do not even want too much, you know, highlight of white or the light. So, set the white balance to ensure accurate color representation. So, what are some of the other considerations when you are collecting data? Your camera position and alignment. So, we have looked at the tripod position, we have looked at how high or low the tripod needs to be in vertical range, in horizontal range.

Let us look at some of the other positions, right? So, mount the cameras at a sufficient distance, we have looked at this before, to capture the entire movement, right? So, you need to also mount it at a sufficient distance to avoid distortion or any kind of obstructions. You do not, you need to avoid vertical distortion, you need to avoid horizontal distortion or any kind of distortion as well, right? So, it needs to be at a sufficient distance. The camera also needs to be in parallel or perpendicular alignment. So, we have looked at this earlier, it either needs to be, if your subject is here, it either needs to be in that direction or this direction. Sometimes you also do have cameras that you can suspend from the top.

So, for example, if the movement is happening here and you have a camera that is suspended from the top. Now, again this would be perpendicular to the action happening down below, right? Now, where would that be important? Imagine you are looking at rotational movements, you are looking at shoulder rotation, you are looking at trunk rotation, you know, in such cases you can mount the camera on top. For example, if you are looking at cricket bowling, you can have a suspended camera on top that allows you to look at extent of rotation, right? So, also as we spoke about, now you can place the

cameras at different angles because what you can see from a sagittal view would be different to what you can see from the frontal view, right? So, place the cameras at varied angles to capture movement from multiple perspectives, right? So, from frontal, right? So, in front sagittal, the side view, so we have looked at before, so that is the front view. You can also place it to have a posterior view or a back view, right? You want to have a look at the movement from the back. You could also have a sagittal view.

Now, sagittal view can be again from the left-hand side and right-hand side depending on what you want to see and if your athlete is left or right-handed. And again, you can have a top view to look at transverse movement in the transverse plane, right? So, you can, so try playing around with the cameras to look at what are you looking at, what movement you know you want to capture, how do you want to capture it, what is your end goal and then what view gives you the best result. Also align the cameras to focus on the specific body segments or joints that are relevant to your game or the movement being analyzed, right? So, for example, in running, you could, if you are looking at the lower limbs, you know the quality of movement that is happening or the efficiency for the lower limbs, you can position the camera in such a way where your lower limbs, your pelvis and your trunk position are intact, right? So, the composition of your frame can have these three segments. So, let us look at some of the other considerations like lighting. So, what are some of the lighting considerations? Ensure that there is consistent and adequate lighting.

So, of course, that is important. You cannot have too much light, you cannot have too little light and it is also important for us to minimize shadows. Now, why would that be important? If you are using this video as an input into any of the softwares, right? If you want to avoid any kind of distortions, then you need to also look at minimizing shadows. So, for that you need consistent adequate lighting, you also need diffused, so you also need diffused lighting and you need even lighting or clear visibility throughout the movement. So, you need consistent adequate diffused, consistent adequate diffused clear visibility and uniform lighting, right? That facilitates accurate, so you can see the body segments accurately and without any shadows. So, what are some of the advantages of qualitative analysis? Let us look at those, right? So, it is extremely easy to set up and execute.

You just have to set up a camera on a tripod. Depending on your goal, you could have one or two sets of cameras, so they allow for simpler setups as compared to quantitative analysis, which you will be looking at in the next couple of videos. The only equipment that you need are the video cameras and the tripod, right? So, your source of investment there is your video camera and your tripod. So, this simplicity of the setup and the mobile access, you can literally pick up your cameras and your tripods and travel with it anywhere. So, this allows us for quicker implementation.

So, the constant requirement for the coaches and for the sports scientists, sorry, specifically when you are looking at technique analysis, right, throughout the sessions, it is an easier way or a more, yeah. It is also cost effective, right? So, your quantitative equipment set of 12 cameras, 14 cameras depends on the setup and what you are trying to achieve could be extremely expensive, right? Because those are infrared cameras, they do the tracking, tracking of the markers. Whereas for qualitative analysis, there is just a video and a tripod, so it is extremely cost effective, right, compared to quantitative analysis. So it also involves softwares as well, but they are not that comparatively, they would be less expensive, right? So, it is relatively affordable and widely available. So, it is adaptability and flexibility as well.

You can pack them, you can take them anywhere, it could be adjustable to any kind of environment and setting which makes them extremely friendly when it comes to diverse applications in research, sport, rehabilitation, clinical settings, right? So, there is not much hassle over there when it comes to the setup. Some other advantages would be timely insights. So again, if you want quick interpretation, the data processing or the data analysis is not that heavy, you can quickly have a look. You can also do them on your phone if you are looking for a quick movement analysis and a quick recap into what is happening. There is immediate visual feedback, right? And timely detection of your movement errors, right? And interpretation of movement patterns.

So, if you are working with an athlete, you can also take your mobile phones out, you can quickly show it to them, replay it for them, this is where you went wrong, it could be knowledge of performance, knowledge of outcome, both can be achieved through this simple tool. So, researchers and coaches can readily observe and interpret most of it quite quickly in time. You do not need any time consuming computations. So, of course, with all these kinds of, you know, advantages and also come the disadvantages as well. As we have looked at, we can just analyze the quality of the movement or its efficiency, but to go into a deeper understanding of insights in terms of, you know, how much force did you produce or kinematic understanding, you would definitely require quantitative analysis, right? So, what are some of the tools for qualitative analysis? Let's look at them.

So, of course, there are different kinds of software that you can use to analyze qualitative data in biomechanics. So, these facilitate, so these tools and software, they facilitate systematic processing, so they allow for systematic processing of movement interpretation as well and visualization at a better scale. So, some of the commonly used software's are Dartfish, right? Silicon coach is another one which is commonly used. There's Kinovea, Qualisys Track Manager and SimiMotion. So, these are some of the software's that you could use for qualitative analysis, right? These are the popular ones.

So, your selection of these software's depends on a number of things. Now, these are, you know, quite acquainted with your data acquisition systems, but you still need to check some of the specific features like the functionalities that you require. So, some software's might have an advantage over the other if you're looking for something specific. So, of course, you need to do a spec analysis or a compatibility analysis with your existing hardware systems that you would have or data acquisition systems. And of course, what are your analytical requirements as well? How complex of an analysis do you need? And your overall workflow preferences as well, right? So, all of these things will determine what software would be ideal for you.

So, what have we looked at in this module? We've looked at what qualitative analysis is. It's the systematic observation and an introspective judgment of the quality, right? Quality of the human movement. So, that's qualitative analysis. So, there's a requirement or a regular requirement to assess, reassess and feedback that helps us monitor progress and ensures the recommended interventions are producing the desired outcomes. So, qualitative analysis is an excellent tool to be able to do that quicker.

Of course, for the consideration of successful qualitative analysis, you need to have appropriate camera positions, setting, lighting, alignment and all of those, some of the considerations that we've looked at earlier for good quality data to be collected. And the advantage of qualitative analysis is the ease of setup, execution, it's cost effective, it's mobile, adaptable, flexible and can have access to timely insights. And some of the softwares that we've looked at include Dartfish, Silicon coach, Kinovea, Qualisys and SIMI motion. So, these are some of them. We've also looked at how you can choose these and better use them. Thank you.